EANS/UEMS European examination in neurosurgery

Variants of questions with answers (compilation - Vyacheslav S. Botev, Department of Neurosurgery, M.Gorky Donetsk National Medical University)

CASE HISTORIES IN GUNSHOT WOUNDS (GSW)

Case 1

2nd Expeditionary Medical Group
Air Force Theater Hospital
Ukraine, 2016

It is 0200. You are on a forward operating base somewhere in southwest Ukraine. The radio in the TOC crackles to life, breaking the silence of the night: "This is Whiskey…Foxtrot…Tango…Niner. Inbound in six mikes with two urgent surgicals from an IED…Requesting a hot off load…TIC in progress… more casualties to pick up…Over".

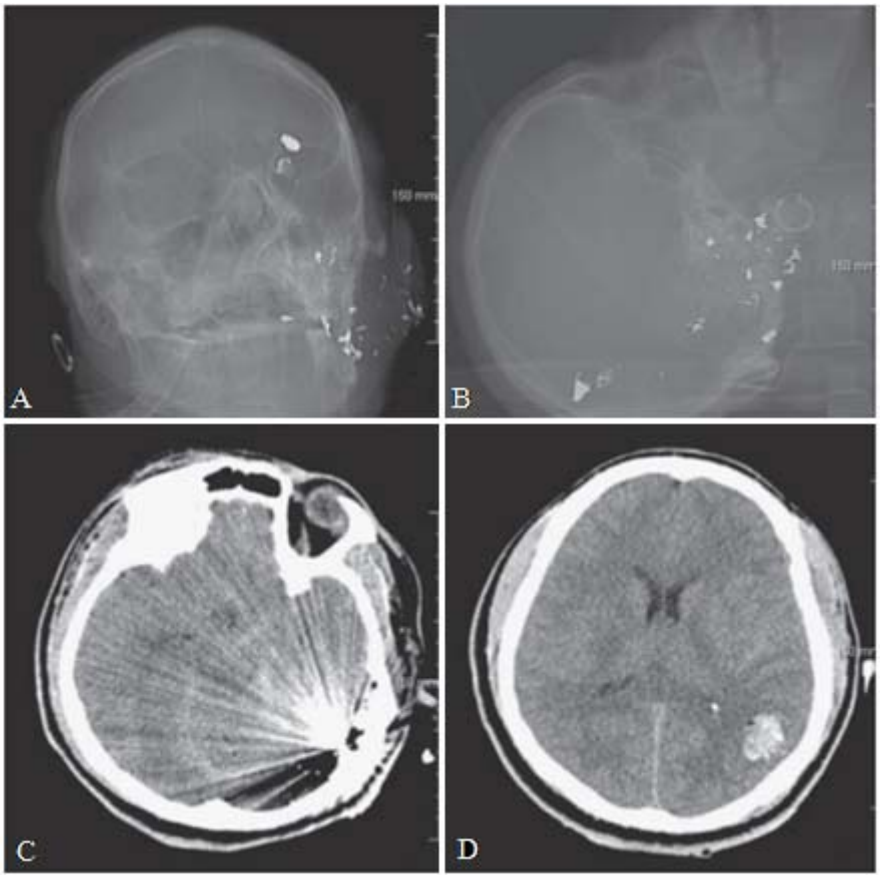
Terminology and Definitions

TOC - Tactical Operations Center
IED - Improvised explosive device
TIC - Troops in contact
Hot Off Load - Unloading or loading of patients into or out of the helicopter while rotors are turning and engine is running.

FST - Forward Surgical Team. Level 2 consists of a 100% mobile surgical team that remains in close proximity to the frontline infantry and provides emergency "damage control" surgery. It typically consists of 20 personnel and two operating tables. It has a 1.5-hour set-up and an 8-hour evacuation time. Portable radiography is the only imaging technology available to the FST.

CSH - Combat Support Hospital. Level 3. Nevertheless, digital X-ray, CT, fluoroscopy, interventional radiology, and ultrasound are usually present at the CSH. The CSH consists of about 250 beds and 550 personnel. These facilities are similar to a moderate-sized community hospital with emphasis on trauma management. Casualties who are not able to return to their units within 1 week are aeromedically evacuated to Level 4 care.

A soldier with severe head injury was brought into the ER. A low-caliber handgun was used. The patient is intubated on arrival. He is awake and agitated. On examination: the pupils are both 3 mm and reactive and he is moving all four extremities purposefully, localizing with both arms. An initial computed tomography (CT) scan is obtained:

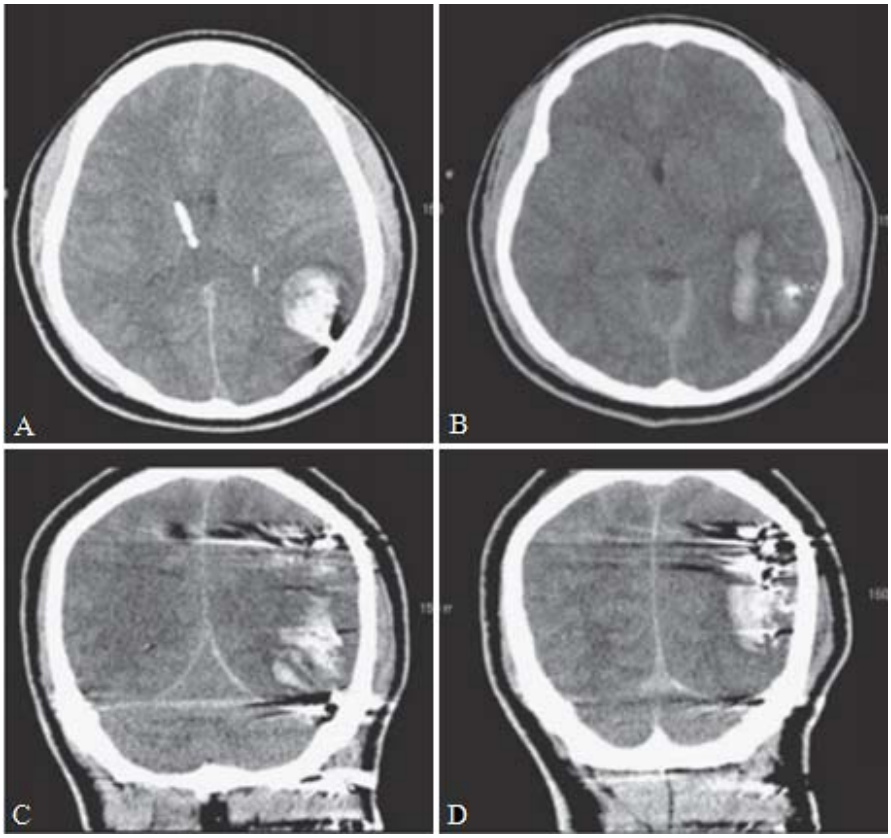


Computed tomography scan of the head. Scout images (A) anteroposterior and (B) lateral as well as pertinent axial images (C) and (D) are shown. The bullet entry site appears to be just under the left mastoid process and the bullet fragments appear to have traveled through the mastoid air cells and are lodged up into the left parietal lobe.

Questions

1. Describe the findings on the CT scan.
2. What is your initial management?
3. Once the patient is stabilized, you elect to place a ventriculostomy. Initial intracranial pressure (ICP) is ~25cm H_2O. What are the measures for treating ICP?

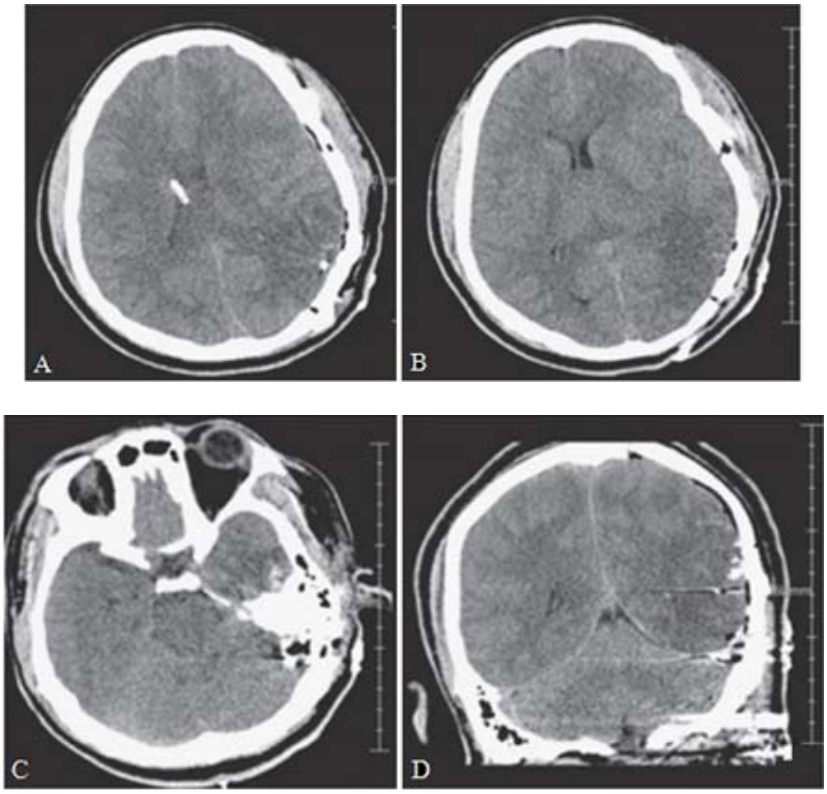
Despite appropriate medical management, he continues to deteriorate. His ICP continues to increase up to 50 cm H_2O and he develops a left dilated pupil ~4 hours after admission. An urgent CT is obtained and shown below.



Computed tomography scan of the head showing pertinent (A, B) axial and (C, D) coronal reconstructed images.

4. Describe the CT scan findings.
5. What is your management at this time?
6. What are the indications to operate on gunshot wounds to the head?
7. What are the contraindications for surgery?

You decide to resect the hematoma and débride the bullet path. Postoperatively, the patient does well for 24 hours, while under sedation and mannitol with head of bed elevated and PCO_2 of 30. His ICP starts increasing from 20 to ~35 cm H_2O. His pupils are still equal and reactive. You cannot obtain further neurologic assessment due to the sedation. Another CT scan done postoperatively:



Computed tomography scan of the head showing pertinent (A–C) axial and (D) coronal reconstructed images. The hematoma has been evacuated. There is significant diffuse brain edema, sulcal effacement, tight basal cisterns, and small ventricles. These findings may be suggestive of increased intracranial pressure.

8. How would you manage the ICP problem now? What are your options?
9. What is the expected prognosis?

Case 2

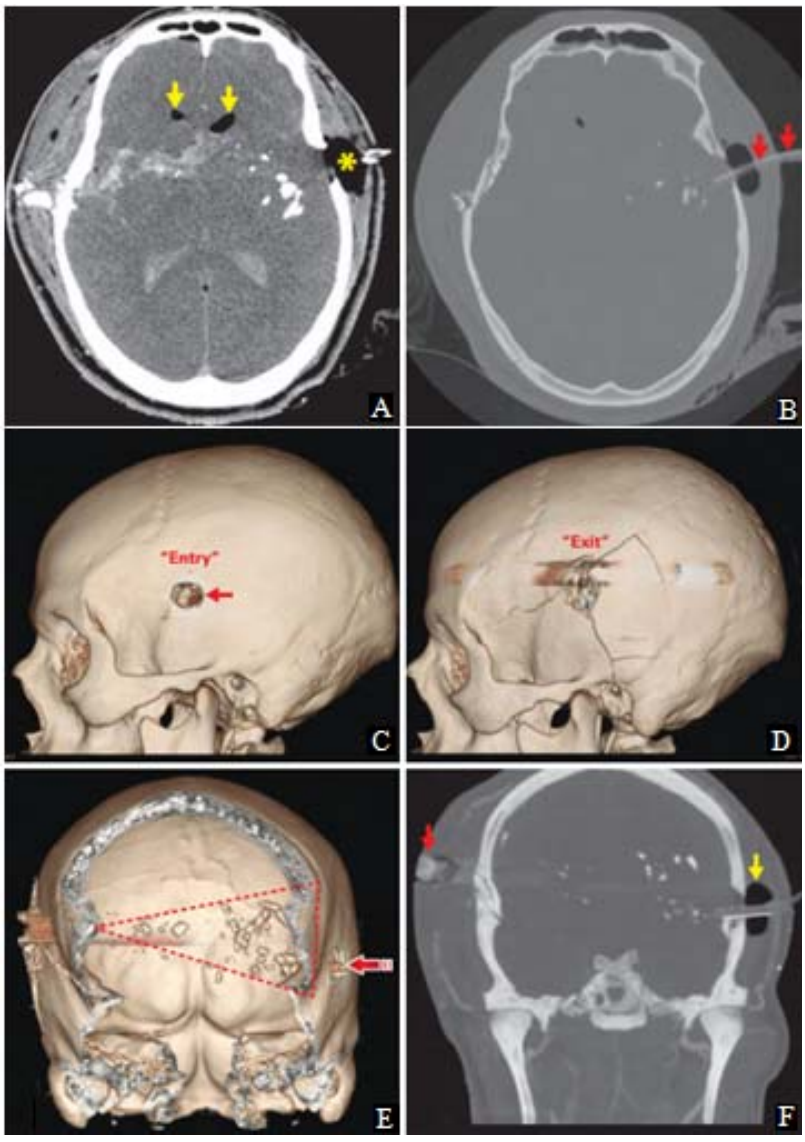
12th Combat Support Hospital
Ukraine, 2016

I was assigned to a Combat Support Hospital (CSH) that took us two hours driving by ground vehicle. It was my first time there; I was nervous about convoys, because we were driving through a heavily attacked route; and my intern classmate (a general surgeon) had been killed in a CSH three weeks ago.

Outside of the resuscitation area, over the whisper of the cold wind, you hear the whir of the rotor blades of the approaching MEDEVAC Blackhawks. Setting down on the landing zone with a deafening roar, all you can see is the static electrical discharge from the spinning rotors. Appearing from the darkness are

wheeled litter carriers bearing casualties and team of attendants racing alongside. Now, it's your turn. This is our calling, the reason we are here…for Warriors.

The soldier victim of a suspected AK-47 perforating round was evacuated within 20 minutes of his injury. An initial computed tomography (CT) scan is obtained:



Questions

1. Describe the findings on the CT scan.
2. What is your planned incision?
3. What is alternative hemicraniectomy incision?

Answers

Case 1

1. Describe the findings on the CT scan.
• Scout images show bullet fragments extending from below the left mastoid through the skull at the level of the mastoid air cells and a larger bullet fragment lodged in the left parietal lobe.
• Axial images show tight but open quadrigeminal cisterns.
• Rostral cuts show small (1.5 cm in diameter) intracerebral hematoma in the left parietal lobe.
• Some diffuse subarachnoid hemorrhage is seen.
• No significant midline shift

2. What is your initial management?
• ABCs of trauma: Insure that the airway is secured, the patient is ventilated, and the blood pressure and pulse are adequate. Resuscitate if needed. Start intravenous (i.v.) line and fluids; place a Foley catheter.
• Admit to intensive care unit (ICU).
• Administer tetanus toxoid.
• Start antiepileptics: load with phenytoin loading dose (1 gram over 1 hour) and give phenytoin 100 mg every 8 hours.
• Provide broad-spectrum antibiotic coverage with both gram-negative and gram-positive coverage (such as nafcillin and ceftriaxone).
• Administer H_2 agonists for ulcer prophylaxis.
• Check laboratory studies: complete blood count, electrolytes, coagulation profile (prothrombin time [PT], partial thromboplastin time [PTT]), type and screen, and toxicology screen
• Consider urgent ventriculostomy placement.
• The patient at this time does not appear to need evacuation of the hematoma or bullet fragments as there is no mass eff ect on the brain. However, he is likely to develop significant swelling and increase ICP in the next 24 hours and will need ICP lowering treatment.

3. Once the patient is stabilized, you elect to place a ventriculostomy. Initial ICP is ~25 cm H_2O. What are the measures for treating ICP?

– Elevate the head of the bed by 30 degrees.
– Make sure there are no constrictions to the patient's jugular venous outflow (collars, etc.).
– Avoid hypotension, hypertension, or hypoxia.
– Hyperventilation to a PCO_2 of 30 to 35 mm Hg may be used as a short-term measure to treat surges in the ICP.
– Mannitol 0.5 to 1 g per kg i.v. infusion – this may be repeated every 4 hours, but one needs to ensure that the serum osmolality is kept lower than 320.
– Sedation with morphine and midazolam drips or alternatively with a fentanyl drip
– Pharmacological paralysis (e.g., with vecuronium)

If the ICP is not controlled after the above measures, serious consideration should be given to repeating the imaging studies and considering surgical evacuation of space-occupying lesions or third tier measures

4. Describe the CT scan findings.
• Expansion of the hematoma to a size of ~3.5 cm in diameter
• Midline shift is now present (of at least 1 cm)

5. What is your management at this time?
• The patient needs urgent surgical evacuation of the hematoma and decompression.
• Options include :
– Craniotomy and resection of hematoma ± debridement of the bullet tract
– Decompressive craniectomy ± hematoma evacuation

6. What are the indications to operate on gunshot wounds to the head?
• Patients with favorable neurologic exam or Glasgow Coma Score (GCS), i.e., patients with none of the contraindications described in the following questions.
• Debridement of devitalized tissue or bone fragments
• Evacuations of a hematoma
• Separation of intracranial component from air sinuses

7. What are the contraindications for surgery?
• Bullet traveling across the midline or the geographic center of the brain
• Bullet traveling across ventricles
• Bullets traveling across more than one contiguous lobe of the brain

8. How would you manage the ICP problem now? What are your options?
• At this time, it becomes necessary to employ second tier measures, as explained in Question 3.
• Also consider the following surgical options:
– Removing the bone flap by performing a craniectomy
– Further debridement of devitalized brain in the area around the tract of the bullet

9. What is the expected prognosis?
• In this case, if the patient gets through the first 72 hours with ICP better controlled, he has a chance of surviving.
• However, he will most likely be severely disabled as the injury did involve eloquent areas of the dominant hemisphere.
• Overall, he has a poor prognosis with survival around 30%.

Case 2

1. **A.** Axial CT image demonstrates multiple bone and bullet fragments traversing diagonally across the midline. There is diffuse cerebral edema and bifrontal intraventricular air (*arrows*). The Foley catheter is noted (*asterisk*), it was inserted because of massive hemorrhaging from the entry site. **B.** Bone windowing reveals characteristic beveling of the inner table of the skull at the entry site and the Foley catheter (*arrows*). **C, D.** Volume-rendered 3D CT images demonstrate the well-defined entry site (*arrow*) and the comminuted fracture at the exit site. This is a classic example of how a bullet punches out a circular wound at the entrance in the skull, driving fragments of bone into the brain. These bone chips create secondary tracks that deviate from the main path and destroy additional tissue. **E.** Coronal 3D cutaway CT image demonstrates the left-to-right trajectory of the GSW with innumerable fragments scattered throughout the brain, most of which are located toward the entry site (*arrow*). Note the cone-shaped distribution of intracranial fragments with the base of the cone centered at the entry size (*triangle*). **F.** Coronal MIP image from the CTA shows many of the abovementioned findings, including the Foley catheter occluding the entry site (*yellow arrow*), beveling of the inner table of the skull, multiple bone fragments along the GSW trajectory, a comminuted fracture at the exit site, and the major ballistic fragment lodged with the right frontotemporal scalp soft tissues (*red arrow*).

2. Planned incision:

Planned incision is a gentle curve (“question mark”) from the midline at the anterior hairline to the base of the zygoma and 1 cm anterior to the tragus. (A) Operative surgeon’s view and (B) lateral view. (C) 5 to 6 equally spaced burrholes.

3. Alternative incision:

Alternative hemicraniectomy incision with midline curvilinear incision with vertical bisecting incision to the root of the zygoma. Originally described by Dr. Ludwig Kempe at the Walter Reed Army Medical Center during procedures for hemispherectomy and reintroduced in the current conflict by Major Jon Martin, MD, while serving in Balad, Iraq, in spring 2007.